

GENETICS (GEN)

Genetics and genomics are central to all aspects of the life sciences. Genetics is the branch of biology that deals with heredity, variation of genes among individuals in a population, and the expression and regulation of genes. Genomics focuses on determining the structure and function of genomes and includes the mapping of genes, high-throughput DNA sequencing, and investigating the molecular mechanisms by which genetic and environmental factors contribute to phenotypes. Every day, scientists are using the tools of genetics and genomics to make exciting discoveries in fields such as molecular medicine, cancer research, biodiversity, and sustainability.

The Genetics (GEN) major has two options: Genetics and Genetics:Genomics. The option in Genetics provides a solid foundation in biology, biochemistry, microbiology, chemistry, physics, math, and cell biology. Students also take advanced courses in molecular genetics, bioinformatics, molecular evolution, genomics, and laboratory techniques. There are many opportunities for interested students to gain research experience through formal or informal research projects in faculty members' laboratories. The Genetics:Genomics option provides additional training in genomics, evolutionary genetics, and computer programming for bioinformatics.

Students with degrees in genetics or genomics are well prepared to apply to graduate schools (e.g., for training as genetic counselors or researchers) and professional schools, or to pursue careers in biotechnology companies, forensics labs, hospitals, university research laboratories, and government agencies. Two additional courses are needed for application to professional programs (e.g., medical or dental school). Graduates may also be employed in fields such as management, sales, marketing, regulatory affairs, technical writing, or science journalism. With supplementary courses in education, graduates with a bachelor's degree in genetics or genomics can teach at the elementary, middle, or high school level.

The genetics faculty conduct research on diverse topics such as evolution, gene structure and function, host-microbe interactions, genome sequencing and analysis, heredity, and diversity in populations. Faculty research areas encompass microbial, plant, and animal genetics. Genetics faculty are committed to mentoring undergraduate students in independent research experiences in their laboratories, which provide students with exposure to and training in cutting-edge research technologies.

Pre-Professional Health Programs

Students interested in postgraduate careers in the health care professions should visit the Pre-Professional Health Programs Advising (<http://www.unh.edu/premed-advising>) website or visit the office in person. Requirements for specific types of professional schools (e.g., medical, dental, physician assistant, pharmacy, etc.) are available here (<http://www.unh.edu/uacc/premed-advising/explore-health-professions>). Students interested in veterinary medicine should consult the Pre-Veterinary Medicine Program (<http://colsa.unh.edu/mcbs/prevet>). Many of the prerequisite courses required by professional schools are also requirements of the genetics major, but students should consult with their faculty adviser to create a plan of study that best prepares them for pursuing a career in one of these health professions.

<http://colsa.unh.edu/mcbs/genetics>

Programs

- Genetics Major (B.S.) (<http://catalog.unh.edu/archives/2017-2018/undergraduate/life-sciences-agriculture/programs-study/genetics/genetics-major-bs>)
- Genetics Major: Genomics Option (B.S.) (<http://catalog.unh.edu/archives/2017-2018/undergraduate/life-sciences-agriculture/programs-study/genetics/genetics-major-genomics-option-bs>)
- Genetics Minor (<http://catalog.unh.edu/archives/2017-2018/undergraduate/life-sciences-agriculture/programs-study/genetics/genetics-minor>)

Courses

Genetics (GEN)

GEN 401 - Professional Perspectives in Genetics

Credits: 1

Introduction to the fields of genetics and genomics and to the genetics faculty and their research. Careers and professional opportunities for genetic majors presented by invited speakers. Emphasis on skills needed for academic success and strategies for achieving professional goals. Cr/F.

GEN 600 - Field Experience

Credits: 1-4

Supervised experience providing the opportunity to apply academic experience in settings associated with future professional employment and/or related graduate opportunities. Must be approved by a faculty advisor selected by the student. Permission required. May be repeated to a maximum of 4 credits. Cr/F.

GEN 604 - Principles of Genetics

Credits: 4

Chemical structure of genetic material, gene recombination, mutation, and chromosome mapping. Gene expression and regulation; recombinant DNA; evolutionary, quantitative, and population genetics. Prereq: BIOL 411 and BIOL 412 or equivalent; CHEM 403 and CHEM 404 or equivalent; or permission. College math or statistics suggested.

GEN 606 - Genetics Lab

Credits: 4

Hands-on experience with some of the important model organisms used for research in genetics (fruit flies, bacteria, yeast, nematodes, and plants). Investigation of fundamental genetic concepts in the laboratory, experience with transmission and molecular genetic techniques, introduction to bioinformatics, analysis and interpretation of data. Prereq: GEN 604. Special fee.

GEN 704 - Genetics of Prokaryotic Microbes

Credits: 5

Maintenance, exchange, and expression of genetic material in bacteria and their viruses. Historical overview of the role microbial genetics played in development of modern molecular biology. Contemporary perspective on methods used to understand the function of genes and their applications to basic science, biomedical research, and biotechnology. Prereq: BMS 503 and BMS 504; GEN 604; or permission. Lab. Special fee. Writing intensive.

Attributes: Writing Intensive Course

GEN 705 - Population and Quantitative Genetics**Credits: 4**

Exploration of the forces (mutations, selection, random, drift, inbreeding, assortative mating) affecting the frequency and distribution of allelic variation in natural populations. Quantifying the structure of populations. Analysis of continuous variation in populations simultaneously at multiple loci. Interactions between genes and their environment underlying phenotypic variation. Methods of analysis for theoretical and practical applications. Prereq: GEN 604; BIOL 528 or equivalent; MATH 424B or equivalent. Computer Lab.

GEN 706 - Human Genetics**Credits: 4**

Genetic basis of human traits and diseases including both traditional methods of diagnosis and contemporary molecular genetic approaches stemming from the human genome project. Case studies exemplify common practices in human genetic counseling and integrate the scientific basis of diagnosis with the special ethical implications of human genetic analysis. Prereq: GEN 604 or permission.

GEN 711 - Genomics and Bioinformatics**Credits: 4**

The methods, applications, and implications of genomics--the analysis of whole genomes are addressed. Medical, ethical and legal implications of genomic data. Computer lab provides exposure and experience in a range of bioinformatics approaches used in genome analysis. Prereq: GEN 604. Computer Lab.

GEN 711W - Genomics and Bioinformatics**Credits: 4**

The methods, applications, and implications of genomics--the analysis of whole genomes. Microbial, plant and animal genomics are addressed, as well as medical, ethical and legal implications. The lab provides exposure and experience on a range of bioinformatics approaches--the computer applications used in genome analysis. Prereq: GEN 604. Lab. Writing intensive. Only offered in Manchester.

Attributes: Writing Intensive Course

GEN 712 - Introduction to Programming for Bioinformatics**Credits: 4**

Development of programming skills that enable life science students to ask fundamental biological questions that require computers to automate repetitive tasks and handle query results efficiently. Topics include: computer values of important parameters of biological sequence data; pattern search and motif discovery scripts; accessing, querying, manipulating, retrieving, parsing, analyzing, and saving data from local and remote databases. Prereq: GEN 604 or permission.

GEN 713 - Microbial Ecology and Evolution**Credits: 4**

Evolutionary and ecological forces that generate the tremendous diversity of microbial life on Earth with emphasis on viruses, archaea and bacteria. Functional roles of microorganisms, their population dynamics and interactions, and their mechanisms of evolutionary change in a variety of environmental settings, including natural communities and laboratory microcosms. Prereq: GEN 604, BMS 503 and BMS 504; or permission. Writing intensive.

Attributes: Writing Intensive Course

GEN 714 - Personal Genomics**Credits: 4**

Analysis and implications of personal genomic data is the focus of this course. Students understand and appreciate all aspects of the availability of personal genomic information and tools including scientific, medical, social, ethical and legal issues. Students have the opportunity to analyse their own individual genome or one of the publicly available genomes to learn about all various aspects of this emerging field. The course will be an entirely online format. Prereq: GEN 604. UNHM only.

GEN 715 - Molecular Evolution**Credits: 4**

Rates and patterns of evolutionary change in biomolecules. Forces affecting the size and structure of genomes. Molecular mechanisms of organismal evolution. Emphasizes integrating evidence from biochemistry, molecular genetics and organismal studies. Methods for reconstructing phylogeny from molecular sequences. Prereq: GEN 604. Some knowledge of statistics is recommended. Computer Lab.

GEN 717 - Molecular Microbiology**Credits: 5**

Fundamental physiological and metabolic processes of archaea, bacteria and fungi with a strong emphasis on prokaryotes. Literature-based course. Topics include regulation of and coordination of microbial metabolism, bacterial cell cycle, global control of gene expression, signal transduction, and microbial cell differentiation. Prereq: BMS 503 and BMS 504; GEN 604; or permission. Special fee. Lab. Writing intensive.

Attributes: Writing Intensive Course

GEN 721 - Comparative Genomics**Credits: 4**

Explores the central questions and themes in contemporary comparative genomics, including genome biology, phylogenomics, human origins, population genomics, and ecological genomics. Provides the conceptual framework required to evaluate new work in this fast-changing field. Prereq: GEN 604 or equivalent.

GEN 771 - Molecular Genetics**Credits: 4**

Structure, organization, replication, dynamics, and expression of genetic information in eukaryotes. Focus on molecular genetic and epigenetic mechanisms of gene expression and its control; molecular genetic control of cell division and differentiation during development. Prereq: GEN 604 or permission.

GEN 772 - Evolutionary Genetics of Plants**Credits: 4**

Mechanisms of genetic change in plant evolution, both in nature and under human influence. Topics include neo-Darwinian theory; speciation and hybridization; origins and co-evolution of nuclear and organelle genomes; gene and genome evolution; transposable elements; chromosome rearrangements; polyploidy; genetic modification. Lab introduces methods in information gathering, bioinformatics, genome analysis, plant breeding, and genetic manipulation. Prereq: GEN 604 or equivalent. Lab. Special fee. Writing intensive.

Attributes: Writing Intensive Course

GEN 774 - Techniques in Plant Genetic Engineering and Biotechnology**Credits:** 4

Theory and hands-on experience with techniques used in plant genetic engineering, including cell and tissue culture, gene cloning, and analysis of foreign gene expression. Discussion of role of plant biotechnology in sustainable agriculture and climate change, modifying plants for better nutrition and stress response, environmental remediation, and production of pharmaceuticals; controversies associated with this technology. Lab. Special fee. Prereq: GEN 604 or permission.

GEN 790 - Undergraduate Teaching Experience**Credits:** 1-4

Provide academic support to graduate teaching assistants or faculty in preparing, presenting, an executing Genetics lectures or labs. May be repeated up to a maximum of 4 credits. Permission required.

GEN 795 - Investigations in Genetics**Credits:** 1-4

Advanced research or scholarly projects developed and conducted under the supervision of a faculty member. Provides the opportunity to apply advanced knowledge and techniques of the major to a specific problem or question. Permission required. May be repeated for a maximum of 4 credits.

GEN 795W - Investigations in Genetics**Credits:** 1-4

Advanced research or scholarly projects developed and conducted under the supervision of a faculty member. Provides the opportunity to apply advanced knowledge and techniques of the major to a specific problem or question. Permission required. May be repeated for a maximum of 4 credits.

Attributes: Writing Intensive Course**GEN 799 - Senior Thesis****Credits:** 1-4

Independent research project under the direction of a faculty sponsor for seniors in genetics. Final product is a written thesis. One or two semesters. May be repeated to a maximum of 8 credits. Permission required. Writing intensive.

Attributes: Writing Intensive Course**GEN 799H - Honors Senior Thesis****Credits:** 1-4

Independent research project under the direction of a faculty sponsor for seniors in genetics and in the Honors Program. Final product is a written thesis. One or two semesters. May be repeated to a maximum of 8 credits. Permission required. Writing intensive.

Attributes: Writing Intensive Course

Faculty

<http://colsa.unh.edu/faculty/all>